

53. The article of claim 52, wherein the multiple dielectric layers alternate between the same higher and lower refractive indices.

54. The article of claim 53, wherein the refractive index ratio between at least two of the dielectric layers is greater than 1.5.

55. The article of claim 54, wherein the lower refractive index is greater than 1.5.

56. The article of claim 45, wherein the refractive index variation is substantially periodic.

57. The article of claim 56, wherein the reflector comprises a one-dimensionally periodic dielectric structure.

58. The article of claim 57, wherein the periodic dielectric structure comprises periodic units each having two or more layers.

59. The article of claim 58, wherein the thickness d_1 and index of refraction n_1 relative to the ambient of a first of the two layers and the thickness d_2 and index of refraction n_2 relative to the ambient of a second of the two layers are chosen to cause:

$$\frac{a \cos\left(-\sqrt{\frac{A-2}{A+2}}\right)}{d_1 n_1 + d_2 n_2} - \frac{a \cos\left(-\sqrt{\frac{B-2}{B+2}}\right)}{d_1 \sqrt{n_1^2 - 1} + d_2 \sqrt{n_2^2 - 1}} > 0,$$

where

wherein the refractive index variation produces a first photonic band gap for a first range of frequencies for electromagnetic energy incident on the surface along the direction perpendicular to the surface from an ambient and a second photonic band gap for a second range of frequencies for electromagnetic energy incident on the surface along a direction approximately 90° from the perpendicular direction from the ambient, and

wherein the refractive index variation is selected to cause the first and second range of frequencies to overlap to define a third range of frequencies for which the reflector exhibits reflection for any incident angle and any polarization.

46. The article of claim 45, wherein the refractive index variation has a spatial extent sufficient for the reflector to exhibit reflection greater than 95% for any incident angle and any incident polarization for frequencies in the third range of frequencies.

47. The article of claim 45, wherein the refractive index variation has a spatial extent sufficient for the reflector to exhibit reflection greater than 98% for any incident angle and any incident polarization for frequencies in the third range of frequencies.

48. The article of claim 45, wherein the ambient has a refractive index substantially equal to about 1.

49. The article of claim 45, wherein the ambient has a refractive index greater than or equal to about 1.3.

50. The article of claim 45, wherein the surface of the reflector is a planar surface

51. The article of claim 45, wherein the reflector comprises multiple dielectric layers along the direction perpendicular to the surface to define the refractive index variation.

52. The article of claim 51, wherein the multiple dielectric layers define alternating higher and lower refractive indices.

53. The article of claim 52, wherein the multiple dielectric layers alternate between the same higher and lower refractive indices.

54. The article of claim 53, wherein the refractive index ratio between at least two of the dielectric layers is greater than 1.5.

55. The article of claim 54, wherein the lower refractive index is greater than 1.5.

56. The article of claim 45, wherein the refractive index variation is substantially periodic.

57. The article of claim 56, wherein the reflector comprises a one-dimensionally periodic dielectric structure.

58. The article of claim 57, wherein the periodic dielectric structure comprises periodic units each having two or more layers.

59. The article of claim 58, wherein the thickness d_1 and index of refraction n_1 relative to the ambient of a first of the two layers and the thickness d_2 and index of refraction n_2 relative to the ambient of a second of the two layers are chosen to cause:

$$\frac{a \cos\left(-\sqrt{\frac{A-2}{A+2}}\right)}{d_1 n_1 + d_2 n_2} - \frac{a \cos\left(-\sqrt{\frac{B-2}{B+2}}\right)}{d_1 \sqrt{n_1^2 - 1} + d_2 \sqrt{n_2^2 - 1}} > 0,$$

where

$$A \equiv \frac{n_2}{n_1} + \frac{n_1}{n_2}, \text{ and } B \equiv \frac{n_2 \sqrt{n_1^2 - 1}}{n_1 \sqrt{n_2^2 - 1}} + \frac{n_1 \sqrt{n_2^2 - 1}}{n_2 \sqrt{n_1^2 - 1}}.$$

60. The article of claim 59, wherein the number of periodic units is sufficiently large for the reflector to exhibit reflection greater than 95% for any incident angle and any incident polarization for frequencies in the third range of frequencies.

61. The article of claim 59, wherein the number of periodic units is sufficiently large for the reflector to exhibit reflection greater than 98% for any incident angle and any incident polarization for frequencies in the third range of frequencies.

62. The article of claim 45, wherein the refractive index variation has an index contrast greater than 1.5.

63. The article of claim 62, wherein the refractive index variation has an index contrast greater than or equal to 2.

64. The article of claim 45, wherein the third frequency range defines a range-midrange ratio defined as $(\omega_2 - \omega_1) / [(1/2)(\omega_2 + \omega_1)]$, where ω_1 and ω_2 are the frequency edges of the third frequency range, and wherein the refractive index variation has an index contrast selected to produce a range-midrange ratio that is greater than 10%.

65. The article of claim 64, wherein the refractive index variation has an index contrast selected to produce a range-midrange ratio that is greater than 20%.

66. The article of claim 64, wherein the refractive index variation has an index contrast selected to produce a range-midrange ratio that is greater than 30%.

67. The article of claim 64, wherein the refractive index variation has an index contrast selected to produce a range-midrange ratio that is greater than 40%.

68. The article of claim 65, wherein the refractive index variation has a spatial extent sufficient for the reflector to exhibit reflection greater than 95% for any incident angle and any incident polarization for frequencies in the third range of frequencies.

69. The article of claim 65, wherein the reflector comprises multiple dielectric layers along the direction perpendicular to the surface to define the refractive index variation.

70. The article of claim 69, wherein the multiple dielectric layers define alternating higher and lower refractive indices.

71. The article of claim 45, wherein the third frequency range is in the infrared.

72. The article of claim 45, wherein the third frequency range is in the visible.

73. The article of claim 45, wherein the third frequency range is in the ultraviolet.

74. The article of claim 45, wherein the third frequency range is in the radio wave region.

75. A method comprising:
directing electromagnetic radiation to the reflector of claim 45 to contact the surface of the reflector at incident angles spanning from 0° to approximately 90° . --

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